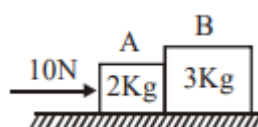


PART-I : PHYSICS

1) A particle has an initial velocity $3\hat{i} + 4\hat{j}$ and an acceleration of $0.4\hat{i} + 0.3\hat{j}$. Its speed after 10s is

- (1) 10 units
- (2) 7 units
- (3) $7\sqrt{2}$ units
- (4) 8.5 units



2) The ground is smooth. The force exerted by B on A is

- (1) 4N
- (2) 6N
- (3) 8N
- (4) 10N

3) A man slides down a light rope whose breaking strength is x times his weights ($x > 1$). The acceleration of the man so that rope just breaks is:

- (1) xg
- (2) $g(1 - x)$
- (3) $\frac{g}{1 + x}$
- (4) $\frac{g}{2 - x}$

4) A uniform chain of length ℓ and mass m is placed on a smooth table with one fourth of its length hanging over the edge. The work that has to be done to pull the whole chain back onto the table

- (1) $\frac{mg\ell}{4}$
- (2) $\frac{mg\ell}{8}$
- (3) $\frac{1}{16}mg\ell$
- (4) $\frac{1}{32}mg\ell$

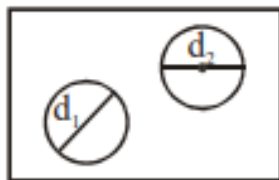
5) For a car taking a turn on a horizontal surface. Let N_1 and N_2 be the normal reactions of the road on the inner and outer wheels respectively.

- (1) N_1 is always greater than N_2
- (2) N_2 is always greater than N_1
- (3) N_1 is always equal to N_2
- (4) Either (A) or (B) depending on the speed of the car and the radius of curvature of the road

6) A thin uniform rod of mass m and length ℓ is free to rotate about its upper end. When it is at rest, it receives an impulse J at its lowest point (normal to its length). Immediately after impact. Choose Incorrect.

- (1) The angular momentum of the rod is $J\ell$
- (2) The angular velocity of the rod is $3J/m\ell$
- (3) The kinetic energy of the rod is $\frac{3J^2}{2m}$
- (4) The linear velocity of the mid point of the rod is $J/2m$

7) Two holes of unequal diameters d_1 and d_2 ($d_1 > d_2$) are cut in a metal sheet. If the sheet is heated.



The distance between the holes will be:

- (1) Increase
- (2) Decrease
- (3) Remain constant
- (4) Is depends on the ratio $\frac{d_1}{d_2}$

8) A metal wire of length ℓ and area of cross section A is fixed between rigid supports at negligible tension. If this is cooled, the tension, in the wire will be

- (1) Proportional to ℓ
- (2) Inversely proportional to ℓ
- (3) Independent of ℓ
- (4) Independent of A

9) The molar heat capacity for an ideal gas

- (1) Cannot be negative
- (2) Must be equal to either C_v or C_p
- (3) Must be in the range $C_v \leq C \leq C_p$
- (4) May have any value

10) A sine wave has an amplitude A and a wavelength λ . Let V be the wave velocity and v be maximum velocity of a particle in the medium.

- (1) V cannot be equal to v
- (2) $V = v$, if $A = \lambda/2\pi$
- (3) $V = v$, if $A = 2\pi\lambda$
- (4) $V = v$, if $\lambda = \frac{A}{\pi}$

11) A heavy uniform rope hangs vertically from the ceiling, with its lower end free. A disturbance on the rope travelling upward from the lower end has a velocity v at a distance x from the lower end

- (1) $v \propto \frac{1}{x}$
- (2) $v \propto x$
- (3) $v \propto \sqrt{x}$
- (4) $v \propto \frac{1}{\sqrt{x}}$

12) A ray of light is incident normally on one face of an equilateral prism of refractive index 1.5. The angle of deviation is -

- (1) 30°
- (2) 45°
- (3) 60°
- (4) 75°

13) Mark the INCORRECT statement :-

- (1) If two independent sources are used in YDSE the resultant intensity at all the points on screen is $2I_0$ where I_0 is intensity of individual source.
- (2) Shape of fringe in a light interference experiment on a screen may be a circle or a hyperbola
- (3) In a Lloyd's mirror experiment zero order fringe is dark fringe
- (4) In the entire width of a fringe in a YDSE intensity remains constant.

14) A point charge Q is moved along a circular path around another fixed point charge. The work done is zero

- (1) Only if Q returns to its starting point
- (2) Only if the two charges have the same magnitude
- (3) Only if the two charges have the same magnitude and opposite signs
- (4) In all cases

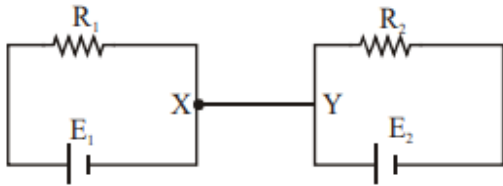
15) A charge Q is placed at the center of the base of a conical flask. The flux of the electric field through the flask is

- (1) Zero
- (2) $\frac{Q}{\epsilon_0}$

(3) $\frac{Q}{2\epsilon_0}$

(4) $< \frac{Q}{2\epsilon_0}$

16) In the circuit shown, the conductor XY is of negligible resistance. Then



(1) Current will flow through XY if $E_1 \neq E_2$

(2) Current will flow through XY if $\frac{E_1}{R_1} \neq \frac{E_2}{R_2}$

(3) Current will flow through XY if $\frac{E_1 + E_2}{R_1 + R_2} \neq \frac{E_1 - E_2}{R_1 - R_2}$

(4) No current will flow through XY

17) The charge flowing through a resistance R varies with time as $Q = at - bt^2$. The total heat produced in R is

(1) $\frac{a^3 R}{6b}$

(2) $\frac{a^3 R}{3b}$

(3) $\frac{a^3 R}{2b}$

(4) $\frac{a^3 R}{b}$

18) A proton moves horizontally towards a vertical conductor carrying a current upwards. It will be deflected

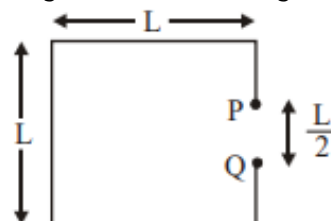
(1) To the left

(2) To the right

(3) Upwards

(4) Downwards

19) The loop shown moves with a velocity v in a uniform magnetic field of magnitude B direct into



the paper. The potential difference between P and Q is e

(1) $e = \frac{B\ell v}{2}$

(2) $B\ell v$

(3) $e = \frac{B\ell v}{4}$

(4) Zero

20) In a sample of radioactive material, what fraction of the initial numbers of active nuclei will remain undisintegrated after half of a half life of the sample

(1) $\frac{1}{4}$

(2) $\frac{1}{2\sqrt{2}}$

(3) $\frac{1}{\sqrt{2}}$

(4) $\sqrt{2} - 1$

21) Backlash error may occur in which of the following instruments

(1) Slide callipers and screw gauge

(2) Spherometer and screw gauge

(3) Slide callipers and spherometer

(4) Slide Callipers, screw gauge and spherometer

22) A thin walled, spherical conducting shell S of radius R is given charge Q. The same amount of charge is also placed at its centre C. Which of the following statement are correct?

On the outer surface of S, the charge density is

(1) $\frac{Q}{2\pi R^2}$

(2) At a point just outside S, the electric field is double the field at a point just inside of S.

(3) At any point inside S, the electric field is inversely proportional to the square of its distance from C

(4) All of the above

23) The gravitational intensity at a distance r from a long thread having λ mass per unit length has the magnitude

(1) $\frac{\lambda G}{r}$

(2) $\frac{2\lambda G}{r}$

(3) $\frac{\lambda G}{2r}$

(4) $\frac{\lambda G}{2\pi r}$

24) A converging glass lens with a refractive index of 1.5 has a focal length of f in air. When it is

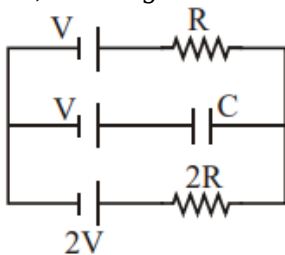
completely immersed in a liquid of refractive index 2, its focal length and nature will be respectively,

- (1) $2f$ and converging
- (2) $3f$ and converging
- (3) $2f$ and diverging
- (4) $3f$ and diverging

25) The radius of gyration of a square plate of side length ℓ about a diagonal is

- (1) $\frac{\ell}{3}$
- (2) $\frac{\ell}{3\sqrt{2}}$
- (3) $\frac{\ell}{2\sqrt{3}}$
- (4) $\frac{\ell}{6}$

26) In the given circuit with steady current, the potential drop across the capacitor must be



- (1) V
- (2) $\frac{V}{2}$
- (3) $\frac{V}{3}$
- (4) $\frac{2V}{3}$

27) When a hydrogen atom emits a photon of energy 12.1 eV, its orbital angular momentum changes by

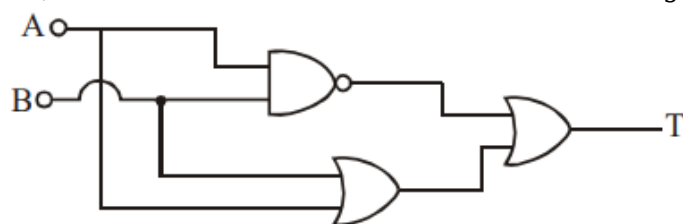
- (1) $1.05 \times 10^{-34} \text{ JS}$
- (2) $2.11 \times 10^{-34} \text{ JS}$
- (3) $3.16 \times 10^{-34} \text{ JS}$
- (4) $4.22 \times 10^{-34} \text{ JS}$

28) When an electron moving at a high speed strikes a metal surface which of the following are possible

- (1) The entire energy of the electron may be converted into an x-ray photon
- (2) Any fraction of the energy of the electron may be converted into an x-ray photon
- (3) The entire energy of the electron may get converted to heat

(4) All of the above

29) The truth table for the circuit shown in the figure is



A	B	Y
1	1	1
(1) 0	1	0
1	0	0
0	0	1

A	B	Y
1	1	0
(2) 0	0	1
1	0	0
0	1	1

A	B	Y
1	1	0
(3) 0	1	0
1	0	0
0	0	0

A	B	Y
1	1	1
(4) 0	1	1
1	0	1
0	0	1

30) In a transistor, α is related to β by the relation

(1) $\beta = \frac{\alpha + 1}{\alpha}$

(2) $\beta = \frac{\alpha - 1}{\alpha}$

(3) $\beta = \frac{\alpha}{1 - \alpha}$

(4) $\beta = \frac{\alpha}{\alpha + 1}$

PART-II : CHEMISTRY

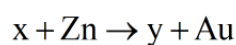
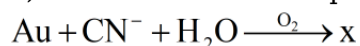
1) Consider two cations 'X' and 'Y' which have 8 and 18 electrons respectively in their outermost shell (both belong to 3d-series). Select the INCORRECT statement:

- (1) Cation 'X' and 'Y' both have 8 electrons in their penultimate shell
- (2) Difference between total number of electrons of 'X' and 'Y' is 10
- (3) Cation 'Y' may be of element 'Ni'
- (4) Cation 'X' may be of element Sc

2) Which of the following statement is **CORRECT**?

- (1) C, Si, Ge are affected by water.
- (2) SiO only exists at low temperature
- (3) SnF_4 and PbF_4 have sp^3 hybridization
- (4) Pb does not show catenation.

3) Given reactions take place during extraction of gold by hydrometallurgy



x and y are respectively.

- (1) $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{CN})_4]^{4-}$
- (2) $[\text{Au}(\text{CN})_2]^{2-}$ and $[\text{Zn}(\text{CN})_4]^{2-}$
- (3) $[\text{Au}(\text{CN})_4]^{3-}$ and $[\text{Zn}(\text{CN})_6]^{4-}$
- (4) $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{CN})_4]^{2-}$

4) Which of the following reaction is an example of reduction of calcined or roasted ore into metal

- (1) $\text{Bauxite ore} + \text{Na}_2\text{CO}_3 \xrightarrow{\text{fused}} \text{NaAlO}_2$
- (2) $\text{Ag}_2\text{S} + \text{NaCN} \rightleftharpoons \text{Na}[\text{Ag}(\text{CN})_2] + \text{Na}_2\text{S}$
- (3) $\text{ZnO} + \text{C} \longrightarrow \text{Zn} + \text{CO}$
- (4) $\text{CuSO}_4(\text{aq.}) + \underset{\text{dust}}{\text{Zn}} \longrightarrow \text{ZnSO}_4 + \text{Cu}$

5) Which of the following compound is known as hydrolith as well as salt like hydride.

- (1) CaH_2
- (2) SrH_2
- (3) NaH
- (4) KH

6) Chromate changes its yellow colour into orange by the addition of

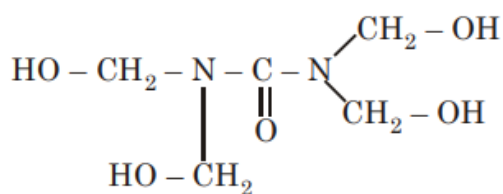
- (1) H_2O
- (2) Acid
- (3) Alkali
- (4) All are correct

7) Consider the following statement which of the following is not true?

- (1) Eu^{+2} is a strong reducing agent (Z of Eu = 63)
- (2) Ce^{+4} is a strong oxidising agent (Z of Ce = 58)
- (3) Curium have electronic configuration $-\text{[Rn]} 5f^7 6d^1 7s^2$ (Z of Cm = 96)
- (4) Yb^{+2} is a oxidising agent (Z of Yb = 70)

8) Which of the following oxide is most basic ?

- (1) V_2O_5
- (2) Cr_2O_3
- (3) MnO
- (4) MnO_2



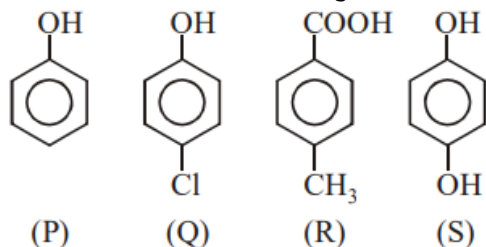
9) $\text{HO}-\text{CH}_2$
The polymer obtained by the above compound is:

- (1) Bakelite
- (2) Urea formaldehyde resin
- (3) Melamine formaldehyde resin
- (4) Teflon

10) Methane can prepared by-

- (1) Kolbe's Electrolysis
- (2) Wurtz reaction
- (3) Carboxylic acid with soda lime
- (4) Sabetier sendrance reaction

11) Decide the decreasing order of acidic nature of following compounds :



- (1) $P > Q > R > S$
 (2) $Q > P > R > S$
 (3) $R > Q > P > S$
 (4) $R > S > Q > P$

12) For a Friedel-Craft reaction using AlCl_3 , which compound can be used as solvent, benzene or nitrobenzene :

- (1) Nitro benzene but not benzene
- (2) Benzene but not nitrobenzene
- (3) Both benzene and nitrobenzene
- (4) Neither benzene nor nitrobenzene

13) Which of the following is not correctly matched

- (1) Antacid-Ranitidine
- (2) Sucrose-Reducing sugar
- (3) Antihistamine-Seldane
- (4) Lactose-Milk sugar

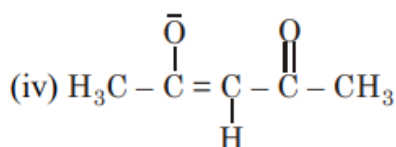
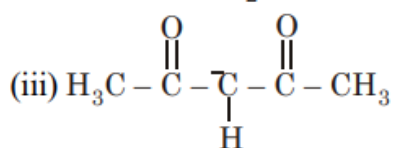
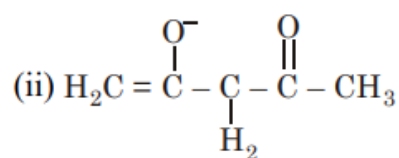
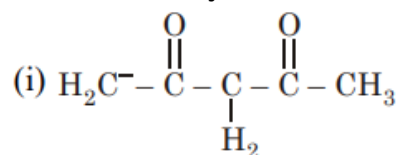
14) Dehydration of 3,3-dimethylbutan-2-ol mainly gives:

- (1) 3,3-dimethylbut-1-ene
- (2) 2,3-dimethylbut-1-ene
- (3) 2,3-dimethylbut-2-ene
- (4) Being 3° alcohol, dehydration is not possible

15) Deficiency of vitamin E causes

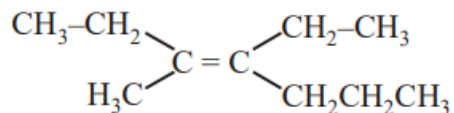
- (1) Scurvy
- (2) Loss of appetite
- (3) Loss of sexual power and reproduction
- (4) Beriber

16) The stability order of the following species is:



- (1) i > ii > iii > iv
 (2) iv > ii > iii > i
 (3) iii > i > ii > iv
 (4) iv > iii > ii > i

17) The IUPAC name of

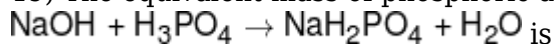


- (1) 4-ethyl-3-methyl-trans-3-heptene
 (2) 4-ethyl-3-methyl-cis-3-heptene
 (3) 5-ethyl-6-methyl-trans-5-heptene
 (4) 5-ethyl-6-methyl-cis-5-heptene

18) 8 gm weak acid HX (molecular mass = 80) is dissolved in 100 ml water. ($K_a = 10^{-4}$)
 Find pH of solution

- (1) 3.3
 (2) 2
 (3) 2.3
 (4) 3

19) The equivalent mass of phosphoric acid (H_3PO_4) in the reaction:

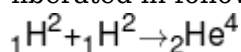


- (1) 25
 (2) 49
 (3) 59
 (4) 98

20) In a reaction, sodium is heated with BaCl_2 . In this reaction, sodium acts as
 $\text{Na} + \text{BaCl}_2 \rightarrow \text{NaCl} + \text{Ba}$

- (1) Oxidizing agent
 (2) Reducing agent
 (3) Hydrolysing agent
 (4) Precipitating agent

21) If binding energy per nucleon of ${}_1\text{H}^2$ is "x" while that of ${}_2\text{He}^4$ is "7x". Then ratio of energy liberated in following reaction & binding energy per nucleon of ${}_1\text{H}^2$ is



- (1) 6
 (2) 24
 (3) 26

(4) 5

22) For the reaction; $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$ rate and rate constant are 1.02×10^{-4} and $3.4 \times 10^{-5} \text{ sec}^{-1}$ respectively, then concentration of N_2O_5 at that time will be

(1) 1.732

(2) 3

(3) 1.02×10^{-4}

(4) 3.4×10^5

23) 1. Consider two 1st order reactions at 25°C with same initial concentrations of 1M

2. A $t_{1/2} = 40 \text{ min}$ product (temperature coefficient = 2)

3. B $t_{1/2} = 30 \text{ min}$ product (temperature coefficient = 3)

If both reaction are carried out at 35°C. Find ratio of concentrations of A & B after one hour.

(1) 1

(2) 2

(3) 4

(4) 8

24) A 0.2 molal aqueous solution of a weak acid (HX) is 20% ionized. The freezing point of this solution is (Given: $K_f = 1.86^\circ \text{C/m}$ for water)

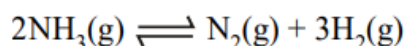
(1) -0.31°C

(2) -0.45°C

(3) -0.53°C

(4) -0.90°C

25) 0.6 mole of NH_3 in a reaction vessel of 2 dm^3 capacity was brought to equilibrium. The vessel was then found to contain 0.15 mole of H_2 formed by the reaction:



Which of the following statement is true?

(1) 0.55 mole of ammonia is left in the vessel

(2) 0.15 mole of the original NH_3 had dissociated at equilibrium

(3) The concentration of NH_3 at equilibrium is 0.25 mole per dm^3

(4) At equilibrium the vessel contained 0.45 mole of N_2

26) Given the correct order of initials T(true) or F(false) for following statements.

(I) Density of crystal always increase due to substitutional defect.

(II) In FCC unit cell closest distance between two tetrahedral void is half of edge length.

(III) In HCP unit cell effective no. of tetrahedral voids are 12.

(IV) On increasing temperature ferromagnetic substance converts to paramagnetic.

(1) T F T F

(2) F T T T

(3) T T F F

(4) T T T T

27) In the decay, ${}^A_ZX \rightarrow {}^{12}_6C + \beta^+$

(1) A = 13, Z = 7

(2) A = 13, Z = 6

(3) A = 12, Z = 7

(4) A = 12, Z = 6

28) A gas at a pressure of 5.0 atm is heated from 0°C to 546°C and simultaneously compressed to one-third of its original volume. Hence final pressure is

(1) 10 atm

(2) 30 atm

(3) 45 atm

(4) 5 atm

29) The rate of effusion of two gases 'a' and 'b' under identical condition of temperature and pressure are in the ratio of 2 : 1. What is the ratio of rms velocity of their molecules if T_a and T_b are in the ratio of 2 : 1 ?

(1) 2 : 1

(2) $\sqrt{2} : 1$

(3) $2\sqrt{2} : 1$

(4) $1 : \sqrt{2}$

30) Which of the following statements is incorrect regarding physisorptions?

(1) Under high pressure it results into multi molecular layer on adsorbent surface

(2) Enthalpy of adsorption ($\Delta H_{\text{adsorption}}$) is low and positive

(3) It occurs because of Van der Waal's forces

(4) More easily liquefiable gases are adsorbed readily

PART-III : MATHEMATICS

1) If ratio of coefficient of 3rd and 4th term in expansion of $\left(x - \frac{1}{2x}\right)^n$ is 1 : 2 then value of n will be-

(1) 18

(2) 16

(3) 12

(4) -10

2) The vectors $\vec{AB} = 3\hat{i} - 2\hat{j} + 2\hat{k}$ and $\vec{BC} = -\hat{i} + 2\hat{k}$ are the adjacent sides of a parallelogram ABCD then the angle between the diagonals is -

(1) $\cos^{-1} \left(\sqrt{\frac{1}{85}} \right)$

(2) $\pi - \cos^{-1} \left(\sqrt{\frac{49}{85}} \right)$

(3) $\cos^{-1} \left(\frac{1}{2\sqrt{2}} \right)$

(4) $\cos^{-1} \left(\sqrt{\frac{3}{10}} \right)$

3) Consider 3 functions f, g, h such that

$$f(x) = x \sin \frac{1}{x}, \quad x \neq 0$$

$$g(x) = x^2 \sin \frac{1}{x^2}, \quad x \neq 0$$

$$h(x) = x^3 \sin \frac{1}{x^3}, \quad x \neq 0$$

Further $f(0) = g(0) = h(0) = 0$, then in $[-1, 1]$ Rolle's theorem is valid for

(1) Both f(x) & g(x)

(2) Only f(x)

(3) Only g(x)

(4) Both g(x) & h(x)

4) Value of expression $\frac{\cos^2 33^\circ - \cos^2 57^\circ}{\sin 21^\circ - \cos 21^\circ}$ is-

(1) $\frac{1}{\sqrt{2}}$

(2) $-\frac{1}{\sqrt{2}}$

(3) $\frac{\sqrt{3}}{2}$

(4) None of these

5) The complete set of values of x for which the function $f(x) = |\operatorname{cosec} x - 2|$ is continuous but not differentiable are -

(1) $2n\pi + (-1)^n \frac{\pi}{6}, \quad n \in \mathbb{I}$

(2) $n\pi + (-1)^n \frac{\pi}{6}, \quad n \in \mathbb{I}$

(3) $(2n+1)\pi + (-1)^n \frac{\pi}{6}, \quad n \in \mathbb{I}$

(4) $n\pi + (-1)^n \frac{\pi}{3}, \quad n \in \mathbb{I}$

6) The value of $\frac{\sin(x+z) - \sin(x-z)}{\cos(y-z) - \cos(y+z)}$ is-

- (1) Independent of x
- (2) Independent of y
- (3) Independent of z
- (4) Dependent on x, y, z

7) Sum of the slopes of the tangents drawn at the intersection points of the curve $y^3 + 3x^2 = 12y$ with axis of ordinate is -

- (1) 0
- (2) $4\sqrt{3}$
- (3) 12
- (4) Not defined

8) If α is the angle subtended by the join of $P_1(x_1y_1)$ & $P_2(x_2y_2)$ at the origin 'O' then, $\cos \alpha$ is equal to:

- (1) $\frac{x_1y_2 + x_2y_1}{OP_1 \cdot OP_2}$
- (2) $\frac{x_1x_2 - y_1y_2}{OP_1 \cdot OP_2}$
- (3) $\frac{x_1y_2 - x_2y_1}{OP_1 \cdot OP_2}$
- (4) $\frac{x_1x_2 + y_1y_2}{OP_1 \cdot OP_2}$

9) The distance from centre to the chord of contact of a circle from any given point on its director circle is α , then the radius of circle is -

- (1) 2α
- (2) $\alpha\sqrt{2}$
- (3) α
- (4) $\sqrt{2\alpha}$

10) Number of three term arithmetic progressions which exist in the set $\{1, 2, 3, \dots, 40\}$ and common difference $d \neq 0$, is-

- (1) 190
- (2) 200
- (3) 380
- (4) 760

11) Which of the following is the correct statement?

- (1) Two circles always have a radical axis

- (2) Three circles always have a radical centre
 (3) Radical axis, if exist, bisects the common tangents of two circles
 (4) If the distance between the centres of two circles is less than the sum of their radii, then circles will have 2 common tangents.

12) If T_m & T_n denotes the m^{th} & n^{th} terms of an A.P. respectively, such that $T_m = \frac{1}{n}$, $T_n = \frac{1}{m}$, then which of the following is necessarily a root of the equation.
 $(a - 3b)x^2 + (2b + 5a)x + (b - 6a) = 0$ -

- (1) T_{mn}
 (2) T_{m+n}
 (3) $T_m + T_n$
 (4) $T_m \cdot T_n$

13) If $z = \sum_{k=1}^{16} \left(\sin \frac{k\pi}{17} - i \cos \frac{k\pi}{17} \right)$, then the principal argument of z is equal to-

- (1) 0
 (2) $\frac{\pi}{2}$
 (3) $-\frac{\pi}{2}$
 (4) π

14) If $ax^2 + bx + c = 0$, then $x =$

- (1) $\frac{b \pm \sqrt{b^2 - 4ac}}{2a}$
 (2) $\frac{2a}{-b \pm \sqrt{b^2 - 4ac}}$
 (3) $\frac{2c}{-b \mp \sqrt{b^2 - 4ac}}$
 (4) None of these

15) Let C_1 and C_2 are concentric circles of radius 1 and $\frac{8}{3}$ respectively having centre at (3, 0) on the argand plane. If the complex number z satisfies the inequality, $\log_{1/3} \left(\frac{|z-3|^2 + 2}{11|z-3| - 2} \right) > 1$ then-

- (1) z lies outside C_1 but inside C_2
 (2) z lies inside of both C_1 and C_2
 (3) z lies outside both of C_1 and C_2
 (4) None of these

16) A three digit number is selected at random from the set of all three digit numbers. The probability that the number selected has atleast two digits same is -

- (1) $\frac{24}{25}$
 (2) $\frac{18}{25}$
 (3) $\frac{9}{25}$
 (4) $\frac{7}{25}$

$$f(x) = \frac{\tan(\pi[x - \pi]^2)}{1 + [x]^4}$$

17) Let $f(x) = \frac{\tan(\pi[x - \pi]^2)}{1 + [x]^4}$, where $[.]$ denotes the greatest integer function then the set of point of discontinuity of $f(x)$ is -

- (1) $\pi + n, \forall n \in \mathbb{I}$
 (2) $\{\pi + n\} \cup (0, 1) \forall n \in \mathbb{I}$
 (3) $[0, 1)$
 (4) ϕ

18) The digits of a number are 1, 2, 3, 4, 5, 6, 7, 8 & 9 written at random in any order. The odds in favour that the number is divisible by 11 is -

- (1) $\frac{11}{126}$
 (2) $\frac{9}{125}$
 (3) $\frac{11}{115}$
 (4) $\frac{7}{112}$

$$f(x) = \begin{cases} \frac{\tan kx}{x} & , \text{ for } x < 0 \\ 3x + 2k^2 & , \text{ for } x \geq 0 \end{cases}$$

19) Let $f(x) = \begin{cases} \frac{\tan kx}{x} & , \text{ for } x < 0 \\ 3x + 2k^2 & , \text{ for } x \geq 0 \end{cases}$ If $f(x)$ is continuous at $x = 0$ then the number of values of k is-

- (1) None
 (2) 1
 (3) 2
 (4) More than 2

20) Coordinates of trisection of line joining points $(-3, -3)$ and $(6, 6)$ are-

- (1) $(0, 0), (3, -3)$
 (2) $(0, 0), (3, 3)$
 (3) $(1, 1), (3, 3)$
 (4) $(1, 1), (-3, 3)$

21) If $\int_0^a \sqrt{x} dx = 2a \int_0^{\pi/2} \sin^3 x dx$; where $a < 4$, then the value of $\int_a^{a+1} x dx =$

(1) 2

(2) $\frac{1}{2}$

(3) $\frac{9}{2}$

(4) $\frac{5}{2}$

22) The polar coordinates of point $(-\sqrt{3}, 1)$ are-

(1) $(2, 5\pi/6)$

(2) $(2, 7\pi/6)$

(3) $(2, \pi/6)$

(4) $(2, 11\pi/6)$

23) If $\int_0^{\pi/3} \frac{\cos x}{3 + 4 \sin x} dx = k \log \left(\frac{3 + 2\sqrt{3}}{3} \right)$ then k is-

(1) $\frac{1}{2}$

(2) $\frac{1}{3}$

(3) $\frac{1}{4}$

(4) $\frac{1}{8}$

24) In how many ways can a mixed doubles tennis game be arranged from 7 married couples, if no husband and wife play in the same game ?

(1) 120

(2) 240

(3) 420

(4) 40

25) The determinant $\begin{vmatrix} {}^x C_1 & {}^x C_2 & {}^x C_3 \\ {}^y C_1 & {}^y C_2 & {}^y C_3 \\ {}^z C_1 & {}^z C_2 & {}^z C_3 \end{vmatrix} =$

(1) $\frac{1}{3}xyz(x+y)(y+z)(z+x)$

(2) $\frac{1}{4}xyz(x+y-z)(y+z-x)$

(3) $\frac{1}{12}xyz(x-y)(y-z)(z-x)$

(4) None

26) The number of all possible selections of one or more questions from 10 given questions, each question having an alternative is :

(1) 3^{10}

(2) $2^{10} - 1$

(3) $3^{10} - 1$

(4) 2^{10}

27) $\begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ bc & ca & ab \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ a & b & c \\ a^3 & b^3 & c^3 \end{vmatrix}$, where a, b, c are distinct positive reals, then maximum value of abc is

(1) $\frac{1}{3}$

(2) $\frac{1}{9}$

(3) $\frac{1}{27}$

(4) $\frac{1}{81}$

$$\Delta = \begin{vmatrix} \cos \frac{\pi}{3} & \cos \frac{2\pi}{3} & 1 \\ -1 & \cos \frac{\pi}{3} & \cos \frac{2\pi}{3} \\ \cos \frac{\pi}{3} & -1 & \cos \frac{\pi}{3} \end{vmatrix}$$

28) The value of Δ is equal to:

(1) 2

(2) $\frac{1}{2}$

(3) $-\frac{1}{2}$

(4) 1

29) $y = \sqrt{\sin x + \sqrt{\sin x + \sqrt{\sin x + \dots}}}$ then $\frac{dy}{dx}$ is not equal to:

(1) $\frac{\cos x}{2y-1}$

(2) $\frac{y}{2 \tan x + y \sec x}$

(3) $\frac{1}{\sqrt{1 + 4 \sin x}}$

(4) $\frac{2 \cos x}{\sin x + 2 y}$

30) If $y = \frac{x}{a+b} \frac{x}{a+b} \frac{x}{a+b} \frac{x}{a+b} \frac{x}{a+b} \frac{x}{a+b} \dots \dots \infty$ then $\frac{dy}{dx}$ -

(1) $\frac{a}{ab + 2ay}$

(2) $\frac{b}{ab + 2by}$

(3) $\frac{a}{ab + 2by}$

(4) $\frac{b}{ab + 2ay}$

31) If $A = \begin{bmatrix} 1 & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$, then A^{50} is -

(1) $\begin{bmatrix} 1 & 25 \\ 0 & 1 \end{bmatrix}$

(2) $\begin{bmatrix} 1 & 0 \\ 25 & 1 \end{bmatrix}$

(3) $\begin{bmatrix} 1 & 0 \\ 0 & 50 \end{bmatrix}$

(4) $\begin{bmatrix} 1 & 0 \\ 50 & 1 \end{bmatrix}$

32) If distance between the directrices be thrice the distance between the foci, then eccentricity of ellipse is -

(1) $\frac{1}{2}$

(2) $\frac{2}{3}$

(3) $\frac{1}{\sqrt{3}}$

(4) $\frac{4}{5}$

33) If $f(n) = \lim_{x \rightarrow 0} \sum_{K=1}^{n^2} \frac{\ln(1 + Kx)}{x}$, $g(n) = \lim_{x \rightarrow 0} \sum_{K=1}^n \frac{e^{K^3 x} - 1}{x}$ then $\lim_{x \rightarrow \infty} \frac{f(x)}{g(x)} =$

- (1) Does not exist
- (2) 2
- (3) 0
- (4) Data inadequate

34) If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$ then the value of $x^{100} + y^{100} + z^{100} - \frac{3}{x^{101} + y^{101} + z^{101}}$ is-

- (1) 0
- (2) 1
- (3) 2
- (4) 3

35) The value of x that satisfies $\tan^{-1}(\tan 3) = \tan^2 x$.

- (1) $\frac{\pi}{3}$
- (2) $-\frac{\pi}{3}$
- (3) $\sqrt{\tan^{-1} 3}$
- (4) None of these

36) The value of $\sin^{-1}(\cos(\sin^{-1}x)) + \cos^{-1}(\sin(\cos^{-1}x))$ is:-

- (1) 1
- (2) 0
- (3) $\frac{\pi}{2}$
- (4) π

37) If $\int \frac{\operatorname{cosec}^2 x - 2009}{\cos^{2009} x} dx = -\frac{A(x)}{(B(x))^{2009}} + c$, then number of solution of the equation $\frac{A(x)}{B(x)} = \{x\}$ in $[0, 2\pi]$ is (where $\{.\}$ represents fractional part function) -

- (1) 0
- (2) 1
- (3) 2
- (4) 3

38) Which one of the following is wrong?

- (1) $\int \tan \theta \sec^2 \theta d\theta = \frac{\tan^2 \theta}{2} + C$
 (2) $\int \tan \theta \sec^2 \theta d\theta = \frac{\sec^2 \theta}{2} + C$
 (3) $\int x \sin x dx = \sin x - x \cos x + C$
 (4) None

39) $\int \frac{x^{9/2}}{\sqrt{1+x^{11}}} dx$ is equal to -

- (1) $\frac{2}{11} \log \left(x^{7/2} + \sqrt{x^7 + 1} \right) + c$
 (2) $\frac{1}{2} \log \left(\frac{x^{11} + 1}{x^{11} - 1} \right) + c$
 (3) $2\sqrt{1+x^{11}} + c$
 (4) $\frac{2}{11} \log \left(x^{11/2} + \sqrt{1+x^{11}} \right) + c$

40) The value of this product of 98 numbers

$\left(1 - \frac{2}{3}\right) \left(1 - \frac{2}{4}\right) \left(1 - \frac{2}{5}\right) \dots \left(1 - \frac{2}{98}\right) \left(1 - \frac{2}{99}\right) \left(1 - \frac{2}{100}\right)$, is-

- (1) $\frac{1}{10}$
 (2) $\frac{98}{100}$
 (3) $\frac{1}{5050}$
 (4) $\frac{1}{4950}$

PART-IV(A) : English Proficiency

1) Select the word which is the exact opposite of the word 'gullible'.

- (1) Trustful
 (2) Easy
 (3) Incredulous
 (4) Exploitable

2) Find the word which is different from the rest. Canoe, Scow, Skiff, Oar, Ferry

- (1) Canoe
 (2) Scow
 (3) Skiff

(4) Oar

3) Unscramble the given letters to find the hidden word that is used to name a particular style of clothing.

CINTU

(1) CUTIN

(2) TUNIC

(3) CUNIT

(4) None of these

4) Select the correct word from the given options to replace the question mark in the given analogy.

Skin : Dermatologist : : Eyes : ?

(1) Ophthalmologist

(2) Optician

(3) Obstetrician

(4) Nephrologist

5) Choose the word which best describes the meaning of the underlined word in the given sentence.

The company is planning to make some lucrative bonds for its upcoming construction project.

(1) Unbreakable

(2) Profitable

(3) Powerful

(4) Corporate

6) Select the correct preposition from the given options to replace the underlined word in the given sentence.

The Grim Sleeper was a very sensitive criminal case and yet the investigators kept barking on the wrong tree for over two decades.

(1) No change

(2) At

(3) Up

(4) Just remove the word

7) Select the most suitable alternative to replace the underlined word in the given sentence to make the sentence grammatically correct.

The florists wreath the flowers into ornaments for the bride to make her look even more beautiful.

(1) No change

(2) Wreathe

(3) Made

(4) None of these

8) Rearrange the given parts of the sentence in correct order.

Mrs. Williams, the school principal, asked us...

- (a) If the length of the story is stretched.
- (b) Not to write the long stories because she fears that.
- (c) Unnecessarily.
- (d) The readers may end up losing interest.

- (1) abcd
- (2) abdc
- (3) dabc
- (4) bdac

9) Fill in the blank with the correct form of the verb in the bracket.

What kind of dresses she _____ (prefer) wearing?

- (1) Prefers
- (2) Has preferred
- (3) May prefer
- (4) Had preferred

10) Fill in the blank with the most suitable conjunction.

Cassie wanted to attend the house party hosted by his best friend; _____, her mother did not think it would be a good idea.

- (1) Yet
- (2) Instead
- (3) However
- (4) Furthermore

PART-IV(B) : Logical Reasoning

1) Identify the figure (out of Figures A, B, C and D) that most closely resembles the unfolded form of

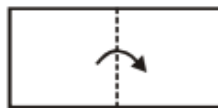


Fig. W

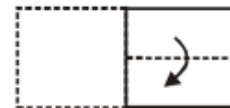


Fig. X

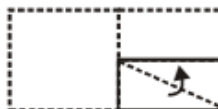


Fig. Y

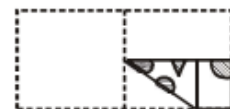
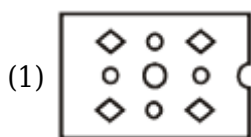
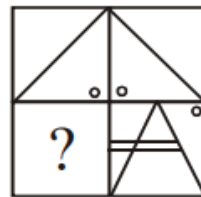
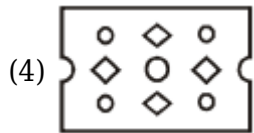
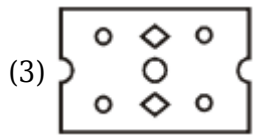
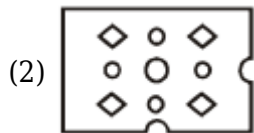


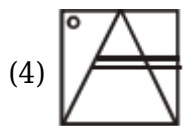
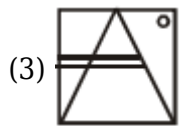
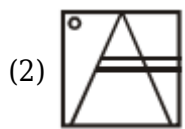
Fig. Z

the figure Z (after cutting out the shaded part).





2) Choose the figure to complete the given pattern.



3) Look at this series:

16, 32, 24, 48, 40, 80, ?

What number should come next ?

(1) 44

(2) 82

(3) 72

(4) 78

4) Select the correct option to replace the question mark in the given analogy.

Hook : Coat :: Thumbtack : ?

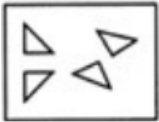
(1) Hammer

(2) Poster

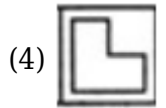
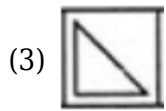
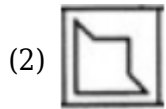
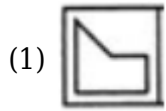
(3) Nail

(4) Wall

5) Find out which of the figures A, B, C and D can be formed from the pieces given in figure (X).



(X)



6) Identify the figure (out of Figures A, B, C and D) that most closely resembles the unfolded form of

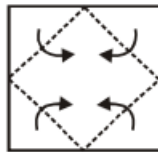


Fig. W

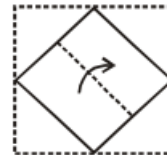


Fig. X

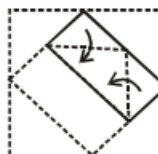


Fig. Y

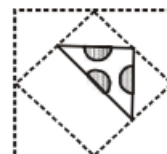
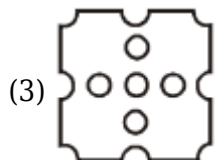
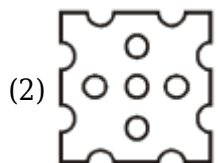
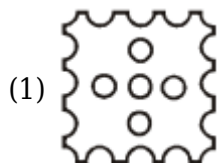
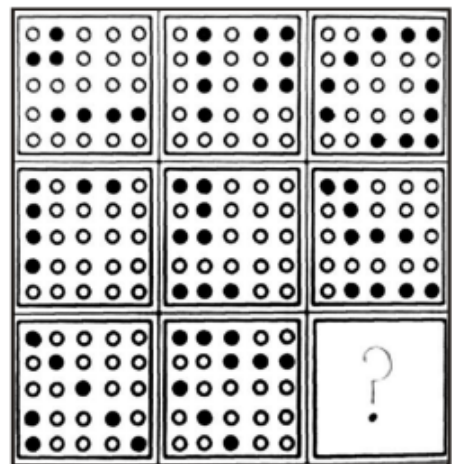
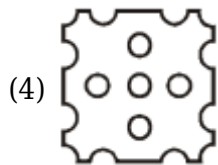


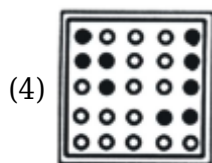
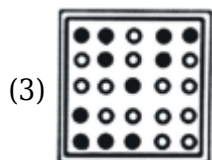
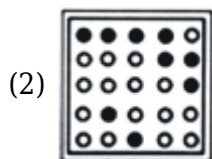
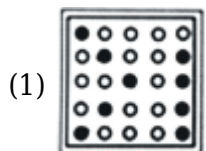
Fig. Z

the figure Z (after cutting out the shaded part).





7) Identify the figure that completes the given figure matrix.



8) Select the correct option to replace the question mark in the given series.

0.5, 1.5, ?, 13.5, 40.5

(1) 4.5

(2) 7.5

(3) 3.5

(4) 9.5

58	64	79
16	?	32
42	16	47

9) Select the correct option to replace the question mark in the given figure.

- (1) 26
- (2) 41
- (3) 48
- (4) 16

10) Read the given statements carefully and select the suitable option to answer which conclusions are correct.

Statements:

Some cats are flowers

All flowers are pencils.

All pencils are papers.

Conclusions:

I. Some papers are bricks.

II. Some pencils are bricks.

III. Some flowers are bricks.

IV. Some are papers.

- (1) Only I and II follow
- (2) Only III and IV follow
- (3) None follows
- (4) All follow

11) **Direction :** In the following letter series what will come in the place of question mark (?)

Z, X, V T, R, ?, ?

- (1) O, K
- (2) N, M
- (3) K, S
- (4) P, N

12) **Direction :** In these questions pair of words to the left of : : have certain relationship with each other. Select the correct alternative so that similar relationship is established to the right of : :

Eye : Myopia : : Teeth : ?

- (1) Pyria
- (2) Cataract
- (3) Eczema
- (4) Trachoma

13) **Direction :** The following questions are based on position number of letters in alphabetic order. Find out the correct answer from the given alternatives and mark it on your answer-sheet as directed.

If PAINT is coded as 74128 and EXCEL is coded as 93596, then how would you encode ACCEPT ?

- (1) 455978
- (2) 547978
- (3) 554978
- (4) 735961

14) **Direction:** In substitution coding some particular objects are assigned as code names and the question is asked that is to be answered in the code language.

If 'Cook' is called 'Butler', 'Butler' is called 'Manager', 'Manager' is called 'Teacher', 'Teacher' is called 'Clerk' and 'Clerk' is called 'Principal', who will teach in a class ?

- (1) Cook
- (2) Butler
- (3) Clerk
- (4) Teacher

15) **Directions :** A successive follow up of directions is formulated and the candidate is required to ascertain the final direction or the distance between two points.

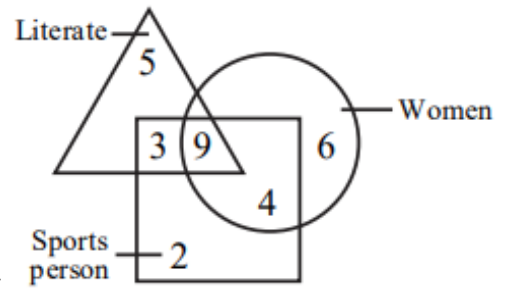
A man is facing north-west. He turns 90° in the clockwise direction and then 135° in the anticlockwise direction. Which direction is he facing now ?

- (1) East
- (2) West
- (3) North
- (4) South

16) How many days will there be from 26th January 2004 to 15th May 2004 (both days included)

- (1) 110
- (2) 111
- (3) 112
- (4) 113

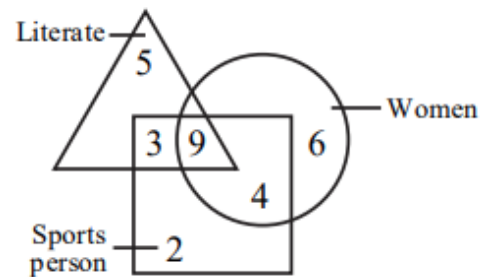
17) **Direction:** are based on the following figure. Triangle represents literate person, circle represents women and square represents sports persons. See the picture carefully and find out the



correct alternative and write its number on your answer sheet
How many persons are literate.

- (1) 5
- (2) 17
- (3) 3
- (4) 8

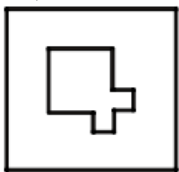
18) **Direction :** are based on the following figure. Triangle represents literate person, circle represents women and square represents sports persons. See the picture carefully and find out the



correct alternative and write its number on your answer sheet.
How many women are literate

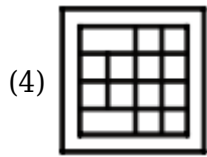
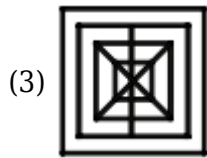
- (1) 6
- (2) 4
- (3) 19
- (4) 9

19) Problem figure



Answer figure

- (1)
- (2)



20) In the following question, arrange the given words in the sequence in which they occur in English dictionary and then choose the correct option

1. Select
2. Seldom
3. Send
4. Selfish
5. Seller

- (1) 1, 2, 4, 5, 3
- (2) 2, 1, 5, 4, 3
- (3) 2, 1, 4, 5, 3
- (4) 2, 5, 4, 1, 3

ANSWER KEYS

PART-I : PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	3	2	2	4	2	4	1	3	4	2	3	3	4	4	3	4	2	4	1	3
Q.	21	22	23	24	25	26	27	28	29	30										
A.	2	4	2	3	3	3	2	4	4	3										

PART-II : CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	3	4	4	3	1	2	4	3	2	3	3	1	2	3	3	4	2	2	4	2
Q.	51	52	53	54	55	56	57	58	59	60										
A.	2	2	4	2	3	2	3	3	3	2										

PART-III : MATHEMATICS

Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	4	4	4	2	2	3	1	4	2	4	3	1	1	3	1	4	4	3	3	2
Q.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A.	2	1	3	3	3	3	3	2	4	4	2	3	2	3	4	3	1	4	4	4

PART-IV(A) : English Proficiency

Q.	101	102	103	104	105	106	107	108	109	110
A.	3	4	2	1	2	3	2	4	1	3

PART-IV(B) : Logical Reasoning

Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	4	4	3	2	3	1	3	1	3	4	4	1	1	3	2	2	2	4	4	3

SOLUTIONS

PART-I : PHYSICS

1) Velocity at any time 't'

$$\mathbf{v} = (3 + 0.4t)\hat{i} + (4 + 0.3t)\hat{j}$$

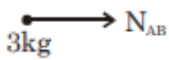
At $t = 10$ sec

$$\mathbf{v} = 7\hat{i} + 7\hat{j}$$

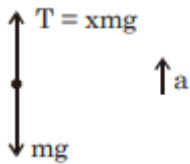
$$\text{Speed} = \sqrt{7^2 + 7^2} = 7\sqrt{2} \text{ m/s}$$

2) Acceleration of blocks = $\frac{10}{5} = 2 \text{ m/s}^2$

FBD of 'B'



$$N_{AB} = 3 \times 2 = 6 \text{ N}$$



3)

$$xmg - mg = ma$$

$$a = (x - 1)g \text{ upwards}$$

$$\text{or } = (1 - x)g \text{ downwards.}$$



4)

$$\text{Work done to pull} = \Delta \text{P.E} = U_f - U_i$$

$$= 0 - \left(-\frac{m}{4} \times g \times \frac{\ell}{8} \right)$$

$$= \frac{mg\ell}{32}$$

6) Angular momentum = $J \times \ell$

$$\text{Angular velocity} \Rightarrow J \times \ell = \frac{m\ell^2}{3} \times \omega$$

$$\omega = \frac{3J}{m\ell}$$

$$\text{KE of rod} = \frac{J^2}{2m}$$

$$\text{Linear velocity of mid point} = \frac{\ell}{2}\omega = \frac{\ell}{2} \times \frac{3J}{m\ell}$$

7)

On increasing temperature, distance between any two points of metal always increases.

$$8) \quad Y = \frac{F}{A \frac{\Delta \ell}{\ell}} \Rightarrow Y = \frac{F}{A \times \propto \Delta T}$$

$$Y \propto \ell^0 \text{ and } Y = \frac{1}{A}$$

9) Molar heat capacity for an ideal gas

$$C = C_V + \frac{R}{1-x} \text{ if } PV^x = \text{constant}$$

10) A general sine wave equation

$$y = A \sin \left(\omega t \pm \frac{2\pi}{\lambda} x + \phi \right)$$

$$\text{Wave velocity} = V = \frac{\omega}{k}$$

Maximum velocity of particle $v = A\omega$

if $V = v$

$$\frac{\omega}{k} = A\omega \Rightarrow A = \frac{1}{k} = \frac{1}{2\pi} \times \lambda$$

11) Wave velocity in the rope $= \sqrt{\frac{T}{\mu}}$

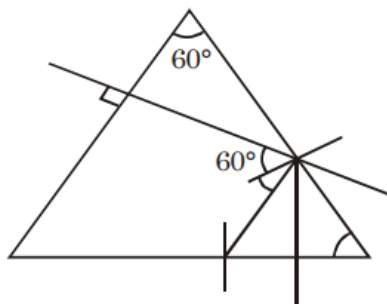


Tension at a distance x from lower end will be

$$= \frac{m}{\ell} xg = \mu xg$$

$$\therefore v_{\text{wave}} = \sqrt{\frac{\mu xg}{\mu}}$$

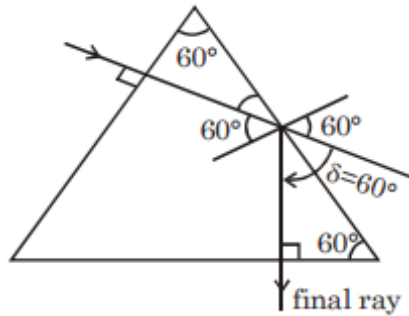
$$\therefore v \propto \sqrt{x}$$



12)

Here $A = 60^\circ$, $r_1 = 0$, $r_2 = A = 60^\circ$

Now the ray suffers TIR i.e.



14) The work done by the central force in a circular path will be zero.

15) Electric flux through flask = $\frac{Q}{2\epsilon_0}$



16) Now current will flow through xy as KCL will be violated

$$17) Q = at - bt^2 = 0$$

$$t = \frac{a}{b} = T$$

$$i = \frac{dQ}{dt} = a - 2bt$$

$$H = \int_{a/b}^0 (a - 2bt)^2 R dt$$

$$= \int_0^{a/b} (a^2 + 4b^2t^2 - 4abt) dt$$

$$= R \left[a^2t + \frac{4b^2}{3}t^3 - 2abt^2 \right]_{a/b}^0$$

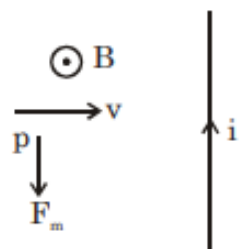
$$= R \left[\frac{a^3}{b} + \frac{4b^3}{3} \frac{a^3}{b^3} - \frac{2aba^2}{b^2} \right]$$

$$= R \left[\frac{a^3}{b} + \frac{4a^3}{3b} - \frac{2a^3}{b} \right]$$

$$= R \left[\frac{4a^3}{3b} - \frac{a^3}{b} \right]$$

$$\frac{a^3 R}{3b}$$

18)

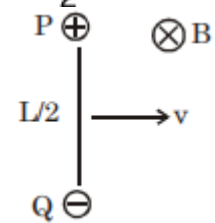


$$\vec{F}_m = q (\vec{v} \times \vec{B})$$

19) In uniform field

$$\varepsilon = \vec{v} \times (\vec{B} \cdot \vec{\ell}_{\text{eff}})$$

$$= \frac{vBL}{2}$$

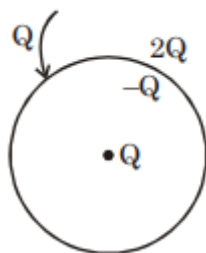


20) $N = N_0 e^{-\lambda t}$

$$\frac{N}{N_0} = e^{-\frac{\ell n 2}{T_h} \frac{T_h}{2}} = e^{-\frac{1}{2} \ell n 2}$$

$$\ell n 2^{-1/2} = 2^{-1/2} = \frac{1}{\sqrt{2}}$$

21) Conceptual



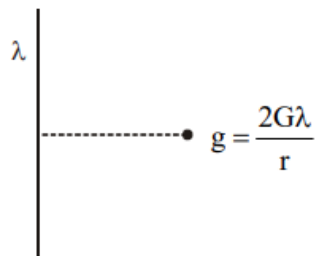
22)

On outer surface $\sigma = \frac{2Q}{4\pi R^2} = \frac{Q}{2\pi R^2}$

EF just outside $= \frac{k(2Q)}{R^2}$

EF just inside $= \frac{k(Q)}{R^2}$ (due to charge at centre)

23)



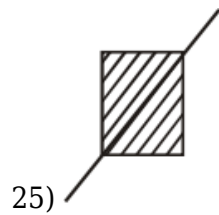
$$g = \frac{2G\lambda}{r}$$

24)

$$\frac{1}{f} = (1.5 - 1) (k) \quad \dots (i)$$

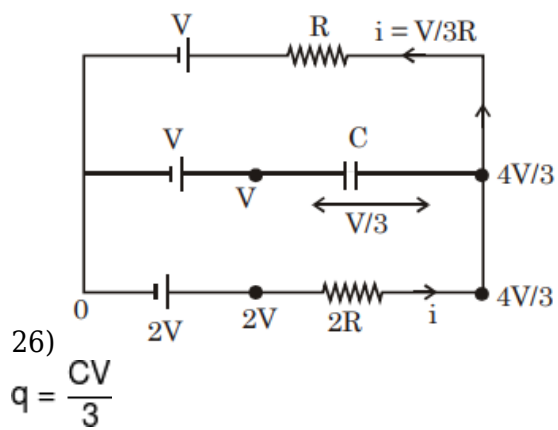
$$\frac{1}{f'} = \left(\frac{1.5}{2} - 1 \right) (k) \quad \dots (ii)$$

$$(i) / (ii) \Rightarrow f' = -2f$$

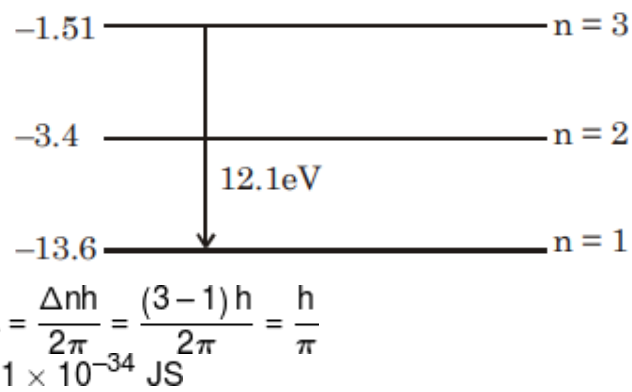


$$I = \frac{m\ell^2}{12} = mk^2$$

$$k = \frac{\ell}{\sqrt{12}}$$



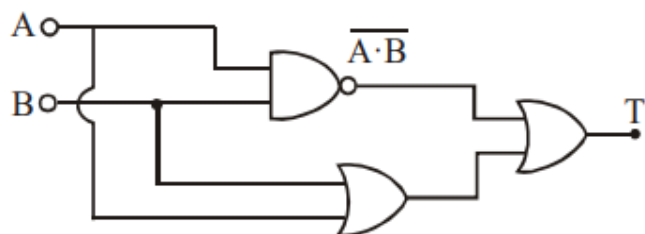
27)



$$\Delta L = \frac{\Delta nh}{2\pi} = \frac{(3-1)h}{2\pi} = \frac{h}{\pi}$$

$$2.11 \times 10^{-34} \text{ JS}$$

28) Conceptual



29)

$$\begin{aligned}
 T &= (\overline{A \cdot B}) + (A + B) \\
 &= \overline{A} + \overline{B} + A + B \\
 &= (A + \overline{A}) + (B + \overline{B}) \\
 &= 1 + 1 \\
 &= 1
 \end{aligned}$$

30) $I_E = I_C + I_B$

$$\frac{I_E}{I_C} = 1 + \frac{I_B}{I_C}$$

$$\frac{1}{\alpha} = 1 + \frac{1}{\beta}$$

$$\frac{1}{\alpha} - 1 = \frac{1}{\beta}$$

$$\beta = \frac{\alpha}{1 - \alpha}$$

PART-II : CHEMISTRY

34)

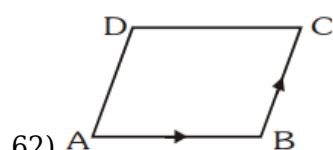
Ans : (C)

42)

Correct option is (A)

Nitrobenzene is used as a solvent in Friedel-Craft's reaction. Nitrobenzene contains an electron withdrawing group. It deactivates the aromatic ring towards electrophilic aromatic substitution reaction. Due to the low reactivity of solvent (Nitrobenzene) it does not participate in the reaction, thus providing a stable medium for the reaction to proceed without interfering.

PART-III : MATHEMATICS



62)

$$\vec{AC} = \vec{AB} + \vec{BC}$$

$$= 2\hat{i} - 2\hat{j} + 4\hat{k}$$

$$\vec{BD} = -\vec{AB} + \vec{BC}$$

$$= -4\hat{i} + 2\hat{j}$$

Let Angle between $\vec{AC}$ & $\vec{BD}$ is θ

$$63) f'(0) = \lim_{h \rightarrow 0} \frac{f(h) - f(0)}{h} = \lim_{h \rightarrow 0} \frac{h \sin \frac{1}{h}}{h}$$

$$= \lim_{h \rightarrow 0} \sin \frac{1}{h} = \text{D.N.E.}$$

$\Rightarrow$ Rolle's theorem not valid

$$g'(0) = \lim_{h \rightarrow 0} \frac{g(h) - g(0)}{h} = \lim_{h \rightarrow 0} h \sin \frac{1}{h^2} = 0$$

$$h'(0) = \lim_{h \rightarrow 0} \frac{h(h) - h(0)}{h} = \lim_{h \rightarrow 0} \frac{h^3 \sin \frac{1}{h^3}}{h} = 0$$

$\Rightarrow$ Rolle's theorem is valid for $g(x)$ & $h(x)$

$$64) \frac{\cos^2 33^\circ - \sin^2 33^\circ}{\cos 69^\circ - \cos 21^\circ} = \frac{\cos 66^\circ}{-2 \sin 45^\circ \sin 24^\circ}$$

$$= \frac{\sin 24^\circ}{-2 \times \frac{1}{\sqrt{2}} \times \sin 24^\circ} = -\frac{1}{\sqrt{2}}$$

65) The function is non-derivable at the points where

$$|\operatorname{cosec} x - 2| = 0 \Rightarrow \sin x = \frac{1}{2}$$

$$x = n\pi + (-1)^n \frac{\pi}{6}, n \in \mathbb{I}$$

$$66) \frac{2 \cos x \sin z}{2 \sin y \sin z} = \frac{\cos x}{\sin y} = \text{Independent of } z.$$

$$67) \text{ For } \frac{dy}{dx}; 3y^2 \frac{dy}{dx} + 6x = 12 \frac{dy}{dx}$$

$$\frac{dy}{dx} = \frac{6x}{12 - 3y^2}$$

all the points lies on y-axis hence $x = 0$

$$\Rightarrow \frac{dy}{dx} \text{ at all the points is zero}$$

$\Rightarrow$ Sum is also zero.

68) Apply cosine rule in triangle OP_1P_2 .

$$OP_1 = \sqrt{x_1^2 + y_1^2}$$

$$OP_2 = \sqrt{x_2^2 + y_2^2}$$

$$P_1P_2 = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\cos \alpha = \frac{(OP_1)^2 + (OP_2)^2 - (P_1P_2)^2}{2 OP_1 \cdot OP_2}$$

$$= \frac{x_1^2 + y_1^2 + x_2^2 + y_2^2 - (x_1 - x_2)^2 - (y_1 - y_2)^2}{2 OP_1 \cdot OP_2}$$

$$= \frac{x_1 x_2 + y_1 y_2}{OP_1 \cdot OP_2}$$

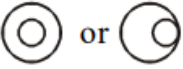
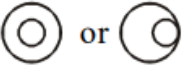
69) Let the circle is $x^2 + y^2 = r^2$, then its director circle will be $x^2 + y^2 = 2r^2$. Any point on this circle $(\sqrt{2}r \cos \theta, \sqrt{2}r \sin \theta)$. . Equation of chord of contact w.r.t. this point will be $\sqrt{2} \cos x + \sqrt{2} \sin \theta y = r$

distance from centre $\frac{r}{\sqrt{2}} = \alpha$
 $r = \sqrt{2}\alpha$

71) (A) False : Because two concentric circle do not have a radical axis.

(B) False : 3 circles having collinear centres do not have radical centre.

(C) True.

(D) False :  or  may be the cases.

72)

$x = 1$ satisfies the equation

$$(a - 3b)x^2 + (2b + 5a)x + (b - 6a) = 0$$

$\therefore x = 1$ is a root of the equation

$$\text{Now } T_m = \frac{1}{n}, T_n = \frac{1}{m}$$

Let A & D be first term and common difference respectively of the AP

$$\text{then } A + (m-1)D = \frac{1}{n} \quad \dots (i)$$

$$A + (n-1)D = \frac{1}{m} \quad \dots (ii)$$

$$\Rightarrow D = \frac{1}{mn}, A = \frac{1}{mn}$$

$$\therefore T_{mn} = \frac{1}{mn} + (mn-1) \frac{1}{mn} = 1$$

$$z = -i \sum_{k=1}^{16} e^{i \frac{k\pi}{17}}$$

$$73) = -i \frac{e^{i \frac{\pi}{17}} (e^{i \frac{16\pi}{17}} - 1)}{(e^{i \frac{\pi}{17}} - 1)} = \frac{e^{-i \frac{\pi}{2}} \cdot e^{i \frac{\pi}{17}} \cdot e^{i \frac{8\pi}{17}} \cdot \sin \frac{8\pi}{17}}{e^{i \frac{\pi}{34}} \cdot \sin \frac{\pi}{34}}$$

$$\therefore \text{Arg} z = \frac{9\pi}{17} - \frac{\pi}{2} - \frac{\pi}{34} = 0$$

$$74) ax^2 + bx + c = 0,$$

$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \times \frac{(-b \mp \sqrt{b^2 - 4ac})}{(-b \mp \sqrt{b^2 - 4ac})}$$

$$\Rightarrow x = \frac{2c}{-b \mp \sqrt{b^2 - 4ac}}$$

76) P(atleast two digit same) = 1 - P(All digits different)

$$= 1 - \frac{9 \cdot 9 \cdot 8}{900} = \frac{7}{25}$$

$$77) f(x) = \frac{\tan(\pi[x - \pi]^2)}{1 + [x]^4} = \frac{\tan(\pi \times \text{integer})}{1 + [x]^4} = 0$$

So the given curve is $y = 0$, which is continuous for all x .

78) 1, 2, 3, 4, 5, 6, 7, 8, 9

$$x + y = 45; x - y = 11 \Rightarrow x = 28; y = 17$$

Now to realise a sum 17 using 4 digits we can have different cases,

$$\begin{bmatrix} 9 & 4 & 3 & 1 \\ 9 & 5 & 2 & 1 \end{bmatrix}; \begin{bmatrix} 8 & 6 & 2 & 1 \\ 8 & 5 & 3 & 1 \\ 8 & 4 & 3 & 2 \end{bmatrix}; \begin{bmatrix} 7 & 6 & 3 & 1 \\ 7 & 5 & 4 & 1 \\ 7 & 5 & 3 & 2 \end{bmatrix};$$

$\begin{bmatrix} 6 & 5 & 4 & 2 \end{bmatrix}$ (9 cases)

If we use five digits then 7, 1, 2, 3, 4 (2 cases) 6, 5, 3, 2, 1

$$\text{Hence } p = \frac{4! \times 5! \times 9 + 5! \times 4! \times 2}{9!}$$

$$= \frac{11 \times 5! \times 4!}{9!} = \frac{11}{126}$$

odd in favour = 11:115

$$\int_0^a \sqrt{x} dx = \frac{a^{3/2}}{3/2} = \frac{2}{3} a^{3/2}$$

81) 0

$$2a \int_0^{\pi/2} \sin^3 x dx = 2a \int_0^{\pi/2} \sin^2 x \sin x dx$$

$$= \int_0^{\pi/2} (1 - \cos^2 x) \sin x dx$$

$$\text{Now use } \sin x = t \text{ to get } 2a \times \frac{2}{3} = \frac{4a}{3}$$

$$\frac{4a}{3} = \frac{2}{3} a^{3/2} \quad 2 = \sqrt{a} \quad a = 4$$

or $a = 0$ or $a < 4$

$$\int_a^{a+1} x dx = \int_a^1 x dx = \left. \frac{x^2}{2} \right|_0^1 = \frac{1}{2}$$

84) 7 male and 7 female

we can select 2 male in 7C_2 ways and then we can't select their wife's. So, we can select 2

females from remaining 5 females in 5C_2 ways. We can arrange them in 2 ways.

So, total ways = ${}^7C_2 \times {}^5C_2 \times 2 = 420$.

So, (3) is correct

$$85) \begin{vmatrix} {}^x C_1 & {}^x C_2 & {}^x C_3 \\ {}^y C_1 & {}^y C_2 & {}^y C_3 \\ {}^z C_1 & {}^z C_2 & {}^z C_3 \end{vmatrix}$$

$$\begin{vmatrix} x & \frac{x(x-1)}{2} & \frac{x(x-1)(x-2)}{6} \\ y & \frac{y(y-1)}{2} & \frac{y(y-1)(y-2)}{6} \\ z & \frac{z(z-1)}{2} & \frac{z(z-1)(z-2)}{6} \end{vmatrix}$$

$$= \frac{xyz}{12} \begin{vmatrix} 1 & x-1 & (x-1)(x-2) \\ 1 & y-1 & (y-1)(y-2) \\ 1 & z-1 & (z-1)(z-2) \end{vmatrix}$$

$$R_1 \rightarrow R_1 - R_2; R_2 \rightarrow R_2 - R_3$$

$$= \frac{xyz}{12} \begin{vmatrix} 0 & x-y & x^2-y^2-3(x-y) \\ 0 & y-z & y^2-z^2-3(y-z) \\ 1 & z-1 & (z-1)(z-2) \end{vmatrix}$$

$$= \frac{xyz(x-y)(y-z)}{12} \begin{vmatrix} 0 & 1 & x+y-3 \\ 0 & 1 & y+z-3 \\ 1 & z-1 & (z-1)(z-2) \end{vmatrix}$$

$$= \frac{xyz(x-y)(y-z)(z-x)}{12}$$

86) For each question there are 3 possibilities selecting 1st, 2nd or none hence total = 3^{10} .
However we have to select atleast 1, so ways = $3^{10} - 1$.

$$87) (a-b)(b-c)(c-a) = (a-b)(b-c)(c-a)(a+b+c)$$

$$\Rightarrow a+b+c = 1 \quad (a \neq b \neq c)$$

As a, b, c are positive

$$\frac{a+b+c}{3} \geq (abc)^{\frac{1}{3}} \quad (AM \geq GM)$$

$$\Rightarrow abc \leq \frac{1}{27}$$

$$\Rightarrow (abc)_{\max} = \frac{1}{27}$$

$$88) \begin{vmatrix} 1/2 & -1/2 & 1 \\ -1 & 1/2 & -1/2 \\ 1/2 & -1 & 1/2 \end{vmatrix} = \frac{1}{8} \begin{vmatrix} 1 & -1 & 2 \\ -2 & 1 & -1 \\ 1 & -2 & 1 \end{vmatrix}$$

$$\frac{1}{8}(g) = \frac{1}{2}.$$

$$89) y = \sqrt{\sin x + y} \quad y^2 = y + \sin x$$

$$\Rightarrow 2y \frac{dy}{dx} = \frac{dy}{dx} + \cos x$$

$$\Rightarrow \frac{dy}{dx} = \frac{\cos x}{2y-1}$$

check all other choices.

$$90) y = \frac{x}{a + \frac{x}{b+y}} \Rightarrow y = \frac{x(b+y)}{ab + ay + x}$$

$$\Rightarrow aby + ay^2 + xy = xb + xy$$

$$\Rightarrow ab \frac{dy}{dx} + 2ay \frac{dy}{dx} = b \Rightarrow \frac{dy}{dx} = \frac{b}{ab + 2ay}$$

91) If we calculate

$$A^2 = \begin{bmatrix} 1 & 0 \\ 2\left(\frac{1}{2}\right) & 1 \end{bmatrix},$$

$$A^3 = \begin{bmatrix} 1 & 0 \\ 3\left(\frac{1}{2}\right) & 1 \end{bmatrix}, \dots, A^{50} = \begin{bmatrix} 1 & 0 \\ 50\left(\frac{1}{2}\right) & 1 \end{bmatrix}$$

$$93) f(n) = \frac{n^2(n^2+1)}{2} \quad g(n) = \left(\frac{n(n+1)}{2}\right)^2$$

$$\lim_{x \rightarrow \infty} \frac{x^2(x^2+1)4}{2(x+1)^2x^2} = 2$$

We have $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$

it is only possible when $\sin^{-1}x = \frac{\pi}{2}$

$\Rightarrow x = 1$

$\sin^{-1}y = \frac{\pi}{2} \Rightarrow y = 1$

$\sin^{-1}z = \frac{\pi}{2} \Rightarrow z = 1$

$\therefore x^{100} + y^{100} + z^{100} - \frac{3}{x^{101} + y^{101} + z^{101}}$

94) $= 1 + 1 + 1 - \frac{3}{3} = 3 - 1 = 2$

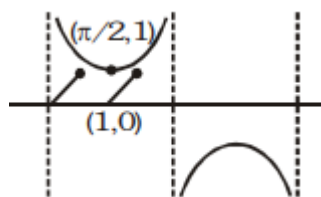
96) For $x \in [-1, 1]$

$\cos(\sin^{-1}x) = \sqrt{1-x^2} = \sin(\cos^{-1}x)$

97) $\int \frac{\operatorname{cosec}^2 x - 2009}{\cos^{2009} x} dx$
 $= \int \cos \operatorname{ec}^2 x \cdot (\cos x)^{-2009} dx - 2009 \int \frac{1}{(\cos x)^{2009}} dx$
 $= I_1 - I_2$

Applying by parts on I_1 ,

we get $\int \frac{\cos \operatorname{ec}^2 x - 2009}{\cos^{2009} x} dx$



$= -\frac{\cot x}{(\cos x)^{2009}} + c$

$\therefore A(x) = \cot x$ and $B(x) = \cos x$

$\Rightarrow \frac{A(x)}{B(x)} = \operatorname{cosec} x = \{x\}$ for $x \in [0, 2\pi]$

The equation has no solution as clear from the graph.

$$I = \frac{2}{11} \int \frac{\frac{11}{2} x^{9/2} dx}{\sqrt{1 + (x^{11/2})^2}}$$

$$x^{11/2} = t$$

$$\frac{11}{2} x^{9/2} dx = dt$$

$$99) \quad I = \frac{2}{11} \int \frac{dt}{\sqrt{1+t^2}} = \frac{2}{11} \log(x^{11/2} + \sqrt{1+x^{11}}) + c$$

PART-IV(A) : English Proficiency

101) The word 'gullible' is an adjective that means 'easily persuaded to believe or do something'. The word 'incredulous' is also an adjective that means 'unwilling to believe or do something'. While the word 'incredulous' is an antonym of 'gullible', all other options are the synonyms. Therefore option 3 is correct.

102) While 'oar' is a long wooden pole with a flat end that is used to row a boat, all others are the different types of boats. Therefore option 4 is correct.

103) The word 'cutin' refers to 'a wax like water repellent that's found in plant cuticles'. 'Cunit' is the name of a town in Spain. The word 'tunic' refers to 'a loosely fitted topwear'. Therefore option 2 is correct.

104) Dermatologist is the doctor who treats skin related diseases. The doctor who treats eye diseases is called Ophthalmologist. Therefore option 1 is correct.

105) Both the words 'lucrative' and 'profitable' have same meaning. Therefore option 2 is correct.

106) Option 3 is correct because 'barking up the wrong tree' is an idiom that means 'moving in a wrong direction' or 'accusing the wrong person'.

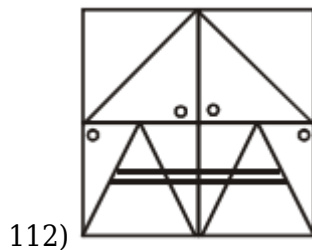
107) 'Wreath' means 'a ring like arrangement of flowers used for decoration', while 'wreathe' means 'cover or surround'. Therefore option 2 is correct.

108) Option 4 is correct.

109) Option 1 is correct because it speaks about someone's habit, so the sentence should be in indefinite tense.

110) Option 3 is correct because the second clause is in contrast with the first

PART-IV(B) : Logical Reasoning



113) This is an alternating multiplication and subtracting series: First, multiply by 2 and then subtract.

114) A hook is used to hang a coat, and a thumbtack is used to hang a poster.

117) Working from left to right, top row then bottom row, the first grid contains a sequence of 3 black dots and a sequence of 4. The next grid contains one of 4 and one of 5. Continue, adding 1 to each sequence every time.

118) The given series is obtained as follows:

$$\begin{aligned} 0.5 \\ 0.5 \times 3 &= 1.5 \\ 1.5 \times 3 &= 4.5 \\ 4.5 \times 3 &= 13.5 \\ 13.5 \times 3 &= 40.5 \end{aligned}$$

119) In each column:

Element in 2nd row = Element in 1st row - Element in 3rd row.

Therefore, missing number = $64 - 16 = 48$

120) III is the converse of the first premise and so it holds.

Some cats are flowers. All flowers are pencils. Since one premise is particular, the conclusion must be particular and should not contain the middle term. So, it follows that 'Some cats are pencils'. II is the converse of this conclusion and so it holds.

All flowers are pencils. All pencils are papers. Since both the premises are universal and affirmative, the conclusion must be universal affirmative and should not contain the middle term. So, it follows that 'All flowers are papers'. Some cats are flowers. All flowers are papers. Since one premise is particular, the conclusion must be particular and should not contain the middle term. So, it follows that 'Some cats are papers'. Thus, IV follows. I is the converse of this conclusion and so it also holds.

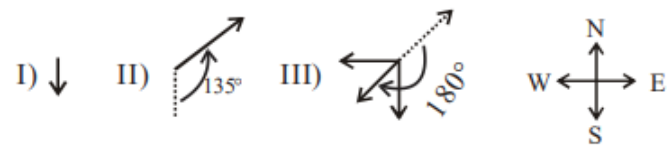
121) $Z \xrightarrow{-2} X \xrightarrow{-2} V \xrightarrow{-2} T \xrightarrow{-2} R \xrightarrow{-2} P \xrightarrow{-2} N$

122) Myopia is the disease in eye, similarly Pyria is a disease of gums attached to teeth.

123)

P A I N T	E X C E L	A C C E P T
7 4 1 2 8	9 3 5 9 6	↓
		4 5 5 9 7 8

124) Teacher is called clerk then clerk will teach in a class.

125) 
 $\therefore S - W$

130) 2. Select

1. Seldom

5. Send

3. Selfish

4. Seller

= 2, 1, 4, 5, 3